

# Analyzing the Communication Clusters in Datacenters

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# General context

- A lot of attention on optimizing datacenter traffic.
- Most papers today focus on sparsity, skeweness<sup>1</sup>, and locality<sup>2</sup>
- Traffic optimization done through black-box models
- We focus on finding explainable patterns in datacenter traffic.

## Our contribution

- Systematic and efficient approach to identify dense clusters
- Analyse quality and stability of found clusters

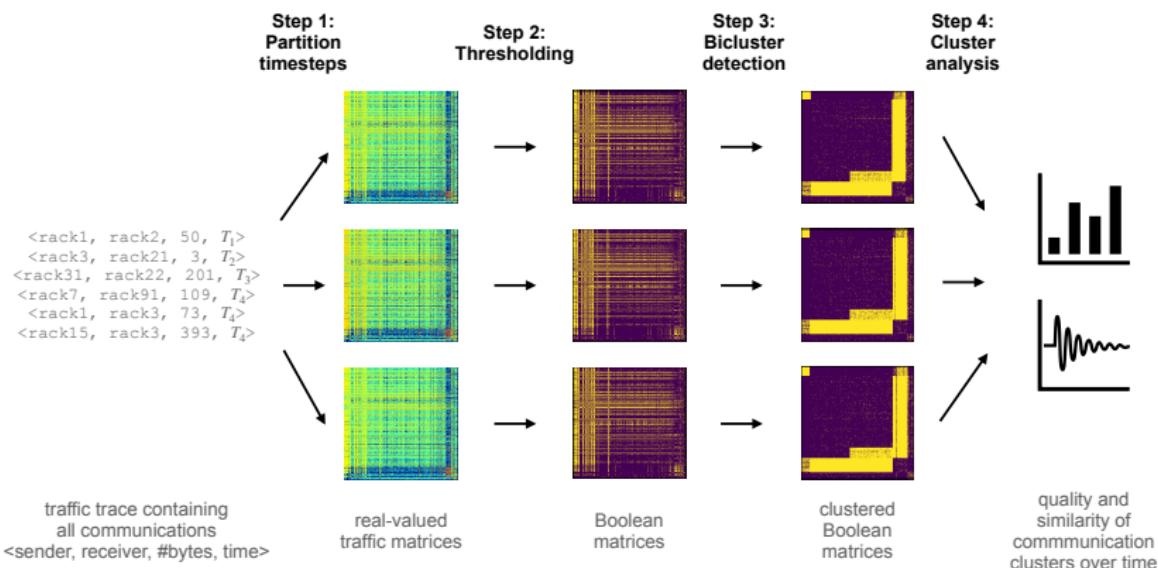
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<sup>1</sup>*ProjecToR Dataset*.

[www.microsoft.com/en-us/research/project/projector-agile-reconfigurable-data-center-interconnect](http://www.microsoft.com/en-us/research/project/projector-agile-reconfigurable-data-center-interconnect). 2016.

<sup>2</sup>Kai Chen et al. “OSA: An Optical Switching Architecture for Data Center Networks With Unprecedented Flexibility”. In: *IEEE/ACM Trans. Netw.* 22.2 (2014), pp. 498–511.

# High level overview of our approach



# Cluster analysis

## Metrics

- Cluster quality
- 
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# Cluster analysis

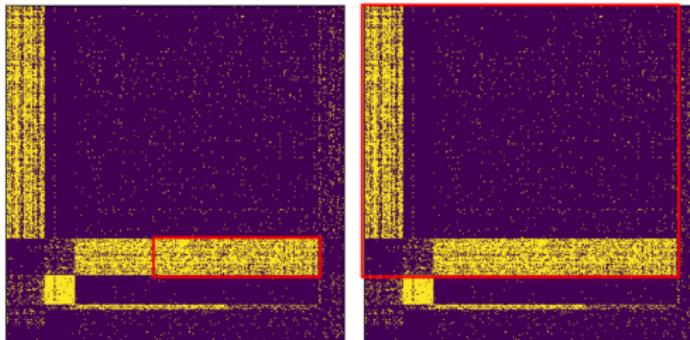
## Metrics

- Cluster quality: Recall and Precision
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# Cluster analysis

## Metrics

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Examples of low recall and low precision clusters.

# Cluster analysis

## Metrics

- Cluster quality: Recall and Precision
- Stability of clusters overtime
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# Cluster analysis

## Metrics

- Cluster quality: Recall and Precision
- Stability of clusters overtime
- Actual traffic inside biclustering

## Case study: Altoona datacenter

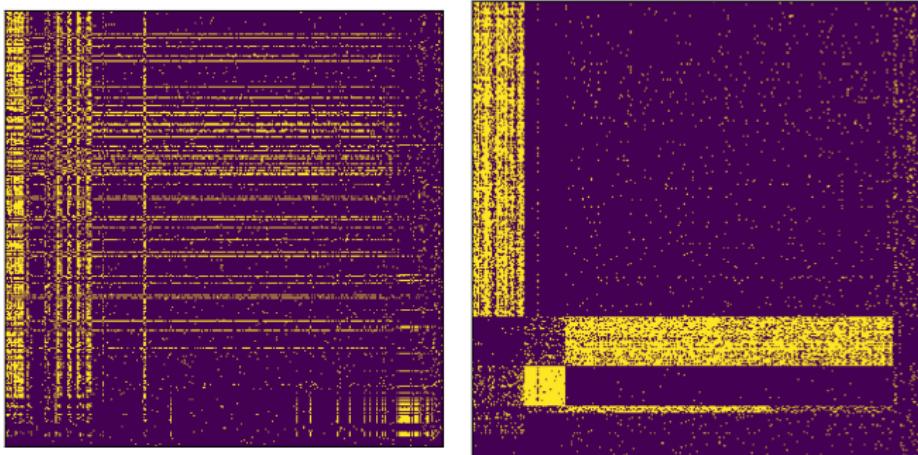
Used a real-world dataset containing actual packet traces (Web, Database, and Hadoop) released by facebook



Altoona datacenter

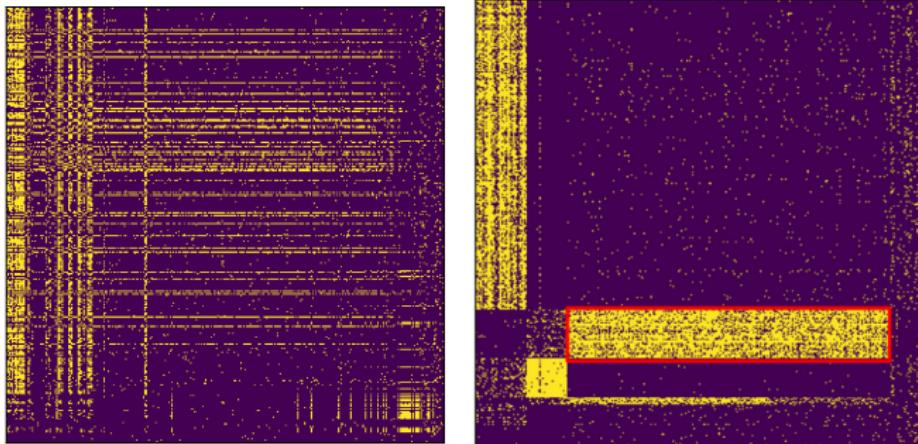
- Traffic over a 150 minutes (2.5 hours) time frame
- Focus on the steady-state behavior
- Partition the 150 minutes of traffic into disjoint time intervals of 1, 5, and 15 minutes

# Clustering reveals Web servers structure



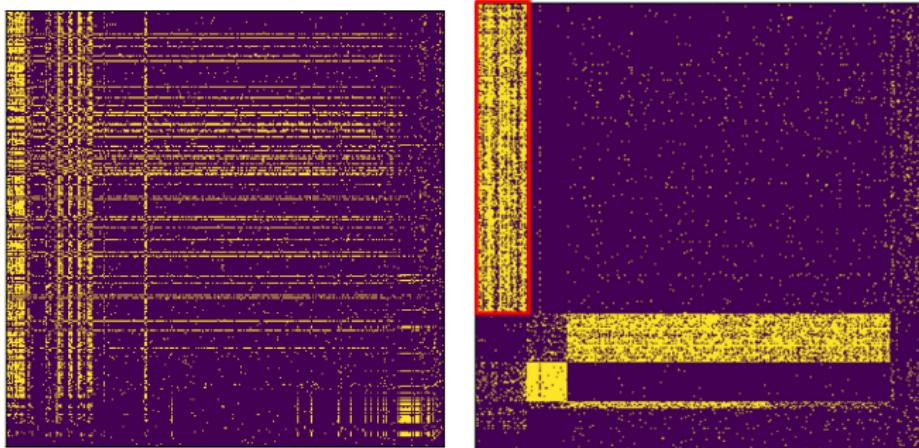
- Rack–rack Web cluster communication
- $p = 70\%$ , 1 minute interval

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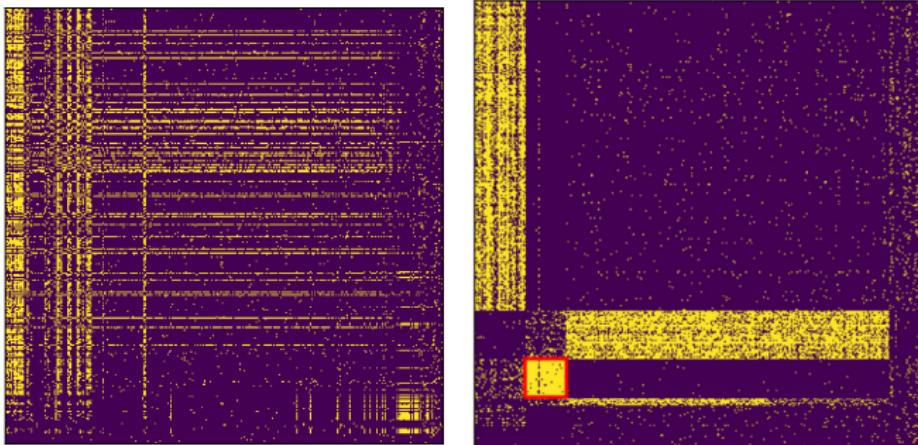
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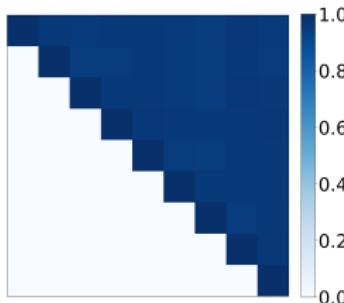
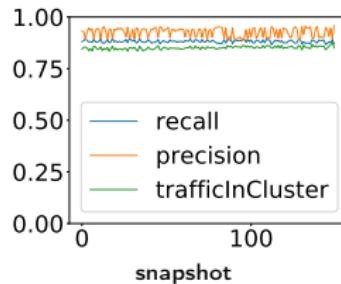
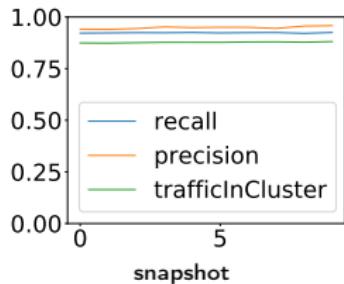
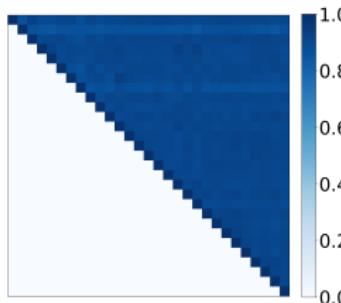
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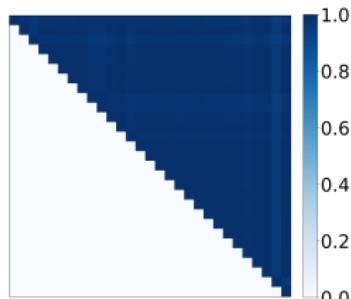
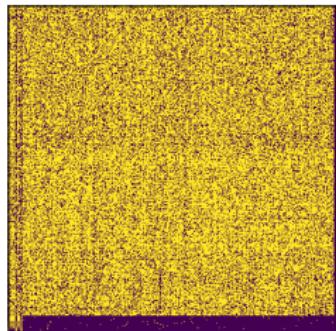


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# High quality clusters recovered for the Web server

15 min,  $p = 70\%$ 5 min,  $p = 70\%$ 1 min,  $p = 50\%$

# Hadoop: a very dense matrix trace.



Hadoop cluster: 5 min,  $p = 30\%$ .

# Conclusion

## Key takeaways

- Find high-quality clusters
- Small clusters are responsible for a significant amount of network traffic
- These clusters are stable over time
- Our methodology only requires a list of endpoint pairs which cause a lot of traffic.

